

Spacecraft Technology Developments 1949-2006

Electronic Intelligence

- Galactic Radiation and Background (GRAB) Experiment — 1st Reconnaissance Satellite

Satellite Tracking/Telemetry

- Minitrack
- Naval Space Surveillance Fence
- Blossom Point, MD Facility

Precision Clocks/Time Transfer/Navigation

- Timation Series — 1st time-transfer spacecraft; 1st Ultrastable Crystal Clock; NTS-I 1st Rubidium Clock
- NTS-II — 1st in GPS constellation; NRL holds patent; 1st Cesium Beam Clock; Hydrogen Maser Clock

Batteries

- NTS-II or GPS 1 — 1st Independent Pressure Vessel flown
- Titan Launch Dispenser — 1st Nickel Hydrogen flown
- Clementine — 1st Common Pressure Vessel (NiH₂) flown
- Shuttle — 1st Sodium Sulphur flown

Onboard Processor/Software

- R3000 — 1st on Clementine
- COMET and Satellite Control Language

Attitude Control/Determination

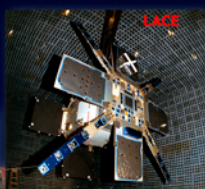
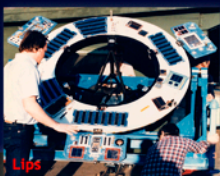
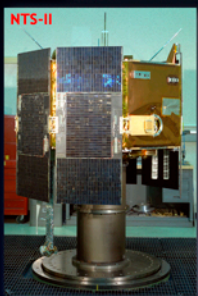
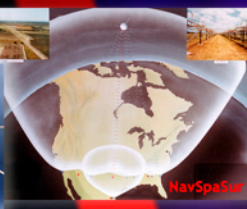
- GGSE-1 — 1st gravity gradient stabilized spacecraft
- GGSE-3 — 1st 3-axis spin gravity gradient stabilized spacecraft
- Clementine — 1st fully autonomous spacecraft
- 1st Attitude Determination Using GPS and Smart Structures

Tether, Mast, and Antenna Technology

- TIPS — Longest lasting spacecraft tether system
- WindSat — 65 dB ortho-mode isolation
- LOFTI — 1st metal ribbon antenna that extends and retracts
- LACE — 1st 150-ft mast that is deployable and retractable

Rocket Plume Shield

- Living Plume Shield (LiPS) Satellite developed by using the normally discarded rocket plume shield as a spacecraft that carried tactical receivers



Advanced Release Technologies

- Frangibolts
- Laser Initiated Ordnance
- Fast Acting Separation Release Nut
- Non-Explosive Separation Nut

Rockets/Propulsion

- Viking Rockets — NRL directed development of eleven vehicles
- Vanguard Rocket — 1st 3-stage rocket
- Solrad-8 — 1st use of gas thrusters
- GGSE-3 — 1st use of microthrusters
- Titan Launch Dispenser
- Hall Effect Thrusters
- Upper Stage



Solar Cells

- Vanguard — 1st spacecraft to be powered by solar cells
- Living Plume Shield (LiPS) — 1st use of Triple Junction cells